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The United States Agency for International Development

Database Needs Assessment for Integrated Water Resources Management in the Souss-Massa Basin

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FORWARD

Collaborative Approaches for Resolving Water Issues

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Database Needs Assessment for Integrated Water Resources Management in the Souss-Massa Basin

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Collaborative Approaches for Resolving Water Issues

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EXECUTIVE SUMMARY

The mission of USAID in Morocco is to assist the Moroccan government by supporting its efforts to achieve integrated management of water resources. The Souss-Massa basin was selected because of the growing problems of water shortages and the crucial importance of agricultural production, tourist activities, and urban development in this region. Souss-Massa is the second most important economic zone of Morocco, and its water resources – particularly its groundwater resources – are subject to increasing pressure which threatens the sustainability of the regional economy. USAID has entrusted this study to FORWARD, which has extensive experience in collaborative methods for participatory management of water resources, especially in the Middle East.

The purpose of this study is to contribute to improving the integrated management of water resources in the Souss-Massa basin through the analysis and improvement of databases, which are the basis for decision-making. The specific objectives are to:

- Analyze the databases used by the agencies in the Souss-Massa basin;
- Evaluate the database requirements of the agencies and make tools available for the management of water resources and decision-making;
- Identify the opportunities and constraints for the exchange of data among the agencies in the basin and make recommendations to overcome the barriers;
- Identify technical and collaborative mechanisms to reach agreement and develop databases regarding the quantities and quality of water in the basin; and
- Assist in developing collaborative mechanisms among the interested parties by developing shared systems of information exchange and tools for integrated water resource management.

Our approach has consisted of working in close collaboration with the effective participation of the interested parties at both the national and the local level. In spite of the difficulties of this participatory approach, it has succeeded; the partners have contributed to enhance the outcome throughout the entire process.

The team identified several specific recommendations which could be the subject of strategic projects to meet the objectives of long-term water resource management in the Souss-Massa basin.

Our analysis confirms that the problems of database requirements are not limited to the creation of a single, shared database for all parties in the Souss-Massa basin. This solution is too simple to meet the current and future needs of regional partners including the future basin agency. Our interviews show the need for a series of parallel and complementary actions. The proposed improvements are a “technological package” involving the databases as well as the upstream and downstream phases (data collection and database use). Our proposals contain actions to:

- Harmonize data collection and acquisition systems;
- Gain better knowledge of the data relative to the groundwater sampling sites;
- Reinforce the use of new data bases;
- Develop geographical information systems related to the databases;
- Create an exchange and inter-partner communication system;
- Strengthen institutions through specialized training;
- Acquire customized hardware; and
- Work together to develop participatory collaborative mechanisms.

The future information systems will provide high performance tools to meet the decision-making needs and to provide better service to users. They will be able to generate such products as a series of thematic and graphic data, figures, maps, and reports in the form of simple sheets or groups of sheets by geographic area. They will also allow real-time access to monitoring data on climate, reservoir levels, groundwater levels, sector consumption, waterway capacity, and water quality parameters. USAID assistance will contribute to this effort.

The recommendations are presented in the following paragraphs:

Harmonize Data Collection-Exchange and Prepare a White Guide

The partners favor developing a standard procedure for data collection, but the recommendation must be adopted with care so that all partners continue to work together. Success depends on their voluntary and effective participation. Implementing a concerted, integrated approach will make better use the inputs of the diverse partners. Harmonization involves all procedures: data collection, measurement methods, organization, data structuring, and identification of methods and opportunities for partial or total data exchange and data sharing.

The following specific actions are essential for consolidating the harmonization process:

- Establish a manual to harmonize data collection systems among partners. It will monitor the relevance of the data, their quality, management, representativeness, record keeping, and facilitate the dissemination of comparable data.

- Ensure a better temporal and spatial representativeness of the water resource parameters monitored by various agencies. A complete regional map indicating all the sampling sites, the parameters monitored, and the responsible agency is a tool to ensure a better regional representative coverage. Improved coverage of the whole region and the entire hydrological cycle will better meet the needs of agencies and users.

- Standardize data collection, analysis, and data exchange methods to facilitate the use of data acquired through various laboratories for monitoring water quality and the condition of the environment.

- Formalize communication among the various agencies through technical monitoring and harmonization committees to ensure sustainability and synergy.

Automate Data Acquisition Systems: Remote Measurement

To improve the quality of the data, shorten the time lag between collection and use of observations, and reduce costs, telemetric systems should be introduced/reinforced to monitor the quantitative and qualitative parameters of water resources in the basin. Telemetric systems constitute an indispensable arsenal to monitor the evolution of water resources and consumption in real time and to guide the management of available resources, especially in case of scarcity. We propose to monitor the following priority intervention areas:

- Surface water resources
- Groundwater resources
- Agricultural consumption in modern and traditional irrigation areas
- Household consumption for urban and rural needs
- Meteorological parameters

Automated monitoring stations make it possible to control and regulate the volume of water distributed to the various sectors in order to save on water consumption in irrigated and urban areas at the level of distribution networks and end users. The automated system also offers tools for controlling the available resources: in the agro-meteorological domain, the stations provide data for hydrological simulations and facilitate the planning and scheduling of irrigation.

Improve Sustainable Management of Groundwater Resources through Knowledge and Control of Groundwater Depletion

Groundwater is the most important resource in the basin and accounts for 67% of the water used. The many studies available confirm the continuous decline of groundwater levels due to excessive pumping. This process seems irreversible and presents great risks for the sustainability of production systems in the region. It is vital to establish methods of monitoring and managing the water table. To do this, a better knowledge of the groundwater resources is urgently needed. Currently, 12,500 wells are catalogued at the level of the ORMVA, and data on boreholes are available at DRH. We recommend completing the available information by the following actions:

- Survey and identify all the wells and boreholes in the region to determine their geographical situation, the authorized rate of water flow, the actual rate, the authorized volumes, volumes consumed, piezometric levels, and water quality;

- Use the new data to prepare a groundwater database which will be used to optimize future decisions related to ground and surface water management;

- Reinforce the hydro-geological knowledge of the aquifers using the database and simulation tools to provide an indispensable decision making tool; and

- Evaluate and apply regulatory and tariff policies in the near future on the basis of these tools and updated data.

Transfer New Information Management Systems

The entities and agencies involved in the planning, management, distribution, use, and protection of water resources have a wide range of systems and databases to meet their daily needs. Each database has been the subject of specific proposals for improvement (Chapter 3). In addition, the analysis has shown that there are recent functioning databases established by DGH, ORMVA, and ONEP. We recommend that the transfer and use of these new and more powerful integrated databases be accelerated at the regional level:

- Assist DGH with its recently developed BADRE21 database, using Oracle, which has powerful operational capabilities. Finalize the development of the database and transfer it to the regional level to accelerate its use (equipment, training, basic data).

- Assist ORMVA with its newly developed management-users database, which allows for complete monitoring of water users and integrates a series of parameters to determine water consumption, crop needs, and the historical record of the farmers. Accelerate the use and development of this database and then transfer it to the level of the subdivisions and CMV (ORMVA county offices = Centre de Mise en Valeur Agricole).

- Assist the regional ONEP to adopt the open and flexible information system being developed at the national level of ONEP.

Develop Geographic Information Systems and Tools to Assist in Decision-Making

We suggest that geographic information systems (GIS) be introduced to make use of the vast amounts of data collected in the region and to build up genuine systems to assist in decision-making. GIS is one of the principal components of the information system. It answers questions that have geographic implications. This data processing tool makes it possible to use, organize, manage, analyze, combine, prepare, and present geographically-indexed information, contributing to better management of geographically located data. The proposed GIS will make it possible to:

- Generate maps (water resources and consumption, condition of the environment);

- Establish rapid mappings and implement interactive spatial choice processes (compare alternatives);

- Bring together data from various sources and combine them in a single system; and

- Detect and react rapidly to any sequence of events or catastrophes that affect a given area.

The design of the GIS may prove to be an excellent area for negotiation and co-ordination. The design process must be appropriate accordingly. To ensure sustainability, we recommended a comprehensive training program that provides all

partners with well-trained personnel. We also recommend transferring the GIS system developed for the USAID/Tadla project, adapting it for Sous-Massa. The achievement of the Tadla project shows that there are tools for resource management, especially water, which have been tested and used in Morocco. The GIS system is completely mastered and used by the staff of ORMVA-Tadla. This is an excellent example to follow since sustainability is assured. The tools continue to be used to improve water resource management beyond the end of the USAID project.

Develop an Information and Management System for Future Needs

The project must be responsive and open to the future in order to meet the needs of the project partners and the future basin agency. The development of an information and management system would be a means of responding to the management needs of the future agency. This system must be designed as a tool for the organizational and financial management of the basin agency. In addition to the quantitative aspects related to water resources, the information system must be a management tool which ensures interfaces with the partners and clients of the agency in the areas of finance and accounting.

Create a Water Resource Observatory

The partners have a long experience of collaboration. Given the scope and urgency of the issues related to sustainable water management, it is advisable to reinforce and formalize the exchanges among partners. We suggest that a water resource observatory, also called an information exchange network, be set up in the Souss-Massa basin. We recommend that the partners should be connected through the intranet and the extranet and that a common participatory Web site be developed. The design of the site is shown in Figure 5.4. It consists of two distinctive components:

- A platform reserved for the partner agencies. This will provide all the agencies with a reserved, specific platform. Each agency will provide the corresponding information.

- A shared, integrated platform. This platform would be developed collaboratively in accordance with the agreements among agencies. It will deal with subjects common to the various parties (management of quality and quantity, regulations, technologies, advice to users…).

To reassure the partners and ensure the successful development of the information exchange network, security and accessibility requirements must be met. The technology, through code systems, makes information secure and provides great protection for sensitive information. In this case, access to information will be reserved only for specialized agencies, which have access codes. The technology also makes it possible to offer information to a wider audience such as users, investors, and NGOs.

Strengthen Human Resources

All the proposals that are put forth should be backed up by corresponding measures to strengthen the human resources of each agency. We recommend that a series of training programs be conducted to meet the identified needs:

- Techniques of automated data acquisition
- Techniques of database design, management, and maintenance
- GIS tools and graphing software
- Systems for implementing and using information exchange networks
- Modeling and simulation techniques (hydrology, agro-climatology)
- Auditing and environmental impact assessment methods

Procure Hardware

The proposals require the procurement of suitable computer equipment. Innovations must include an improvement in the nature, architecture, and capacities of the hardware by adding servers/clients, the required connectivity, appropriate back-up systems, and GIS platforms. These platforms in particular require scanners, digitizers, and graph plotters. Exact needs will be determined in accordance with the selected priority recommendations.

Strengthen Participatory Cooperation

These recommendations and the success of integrated water management in Souss-Massa require an innovative and dynamic institutional effort. The creation of the National Committee for the Souss-Massa Integrated Water Management Project (SIWM) is a first step in improving water resource management. This committee, composed of representatives from DGH, AGR, and SSE, was instrumental in developing the initial workshop of SIWM, held in Agadir on 26 and 27 April 2000. The committee brought together national and regional entities which plan, manage, and develop water resources at the national and regional levels. The workshop began with an examination of national and international experiences in river basin management. Participants divided into three subcommittees to explore issues related to basin management including institutional and legal aspects, best practices and pilot projects, decentralization and good governance. The subcommittees, composed of representatives from the various agencies, worked for two days to prepare proposals for achieving integrated water resource management.

The workshop sessions were characterized by open, frank, and in-depth discussions. We recommend the creation of a SIWM regional committee and task forces, including one on information systems and databases, to address specific technical issues related to SIWM implementation. The participatory and teamwork approaches, which were so successful during the FORWARD study and at the Agadir workshop, should be expanded to foster a sense of ownership among all the parties.

These ten recommendations – which were identified by FORWARD – will help to develop collaborative and participatory approaches for integrated water resource management. The emphasis must be on strengthening cooperative planning among

ministries, agencies, and other stakeholders. Certain conditions for the success of joint collaboration and plans of action are presented in the body of the report.

CHAPTER 1
INTRODUCTION

The mission of the United States Agency for International Development (USAID) in Morocco is to provide the Moroccan government with assistance to strengthen its efforts in integrated water resource management. The Souss-Massa basin was chosen because of the increasing water shortage and the crucial importance of the agricultural sector, tourism activities, and urban development. Souss-Massa has become the second economic zone in Morocco. Water resources, especially groundwater, are subject to increasing pressure that will, unless it is contained, affect the sustainability of the economy. USAID has entrusted FORWARD, which has a long experience in collaborative participatory approaches in water resource management, especially in the Middle East, to implement this database study in collaboration with interested parties at the national and local levels. Together they will explore the possibilities for sharing information to achieve a more integrated and participatory water management.

Aims of the Study and the Terms of Reference

The objectives of this study, as laid down by the terms of reference, relate to the diagnosis of existing databases and the assessment of future database needs for an integrated water resource management in the Souss-Massa basin. Some of the specific objectives are as follows:

- Diagnose the databases used by the agencies in the Souss-Massa;
- Evaluate the database needs of the agencies and provide them with water resource management and decision-making tools;
- Identify the opportunities and constraints of the agencies in the Souss-Massa for exchanging data and propose recommendations for overcoming these barriers;
- Identify technical and collaborative procedures needed to reach agreement on database development for water quantity and quality in the basin; and
- Contribute to the development of collaborative procedures between the concerned parties by developing systems for sharing information and databases, which are tools for integrated water resource management.

General Framework of the Study Zone

Souss-Massa hydrological basin covers about 27,000 square kilometers. The zone is limited to north by the High-Atlas and to the south by the Anti-Atlas. The Souss-Massa basin has a strategic importance within the economy of Morocco: it provides more than 50% of the exported agricultural produce, particularly citrus fruit and early vegetables; it constitutes a fast-growing urban and industrial zone, second to Casablanca; and it has a prosperous tourism sector. Intensive irrigation development, urban and industrial growth, and the expansion of tourism increase the demand for

water resources. The situation is aggravated by the arid ecological conditions of the basin. There is a chronic water shortage and water quality is likely to worsen.

The Souss and Massa rivers are the principal sources of surface water in the basin. The quantity of surface water normally available each year varies from 341 to 635 million cubic meters. However, this can drop to 35 million cubic meters when the region is affected by drought (recorded in 1960-61). Surface water is collected and stored upstream in three dams: Abdel Moumen, Aoulouz, and Youssef Ben Tachfine. Two other reservoirs, Dhkila and Imi El Kheng, have a lower capacity. The total capacity of the five reservoirs exceeds 651 million cubic meters.

Groundwater, which is the principal source of water in the area, is extracted mainly from alluvium in the Souss valley. The recharge capacity is around 450 million cubic meters per annum depending on rainfall. More than 13,000 wells are exploited to extract groundwater for industrial agricultural and domestic uses. The quality of the water of alluvium is generally good. The majority of the wells produce water of a rather good quality. However, in certain wells, there is some deterioration in water quality. In many areas farmers and urban users receive lower quality water due to salinity and organic, microbial, and chemical pollution.

The causes of the deterioration of the quality of groundwater and surface water vary over time. Presently, the most significant causes are as follows:

- Overexploitation of groundwater
- Agricultural, industrial, and urban pollution
- Direct discharge of untreated wastewater into rivers and estuaries

This degradation extends beyond the contamination zone and may be hazardous to the estuaries, public health, tourism, and urban development.

Methodological Approach of FORWARD

Our experience on the international level shows that water problems are often viewed as technical issues that can be resolved through specialist expertise. FORWARD feels that these problems are usually the result of differing views of the concerned parties, which prevent them from reaching consensus and fulfilling their commitments. Even setting up a database on water resources, which would seem to be a simple and direct undertaking, taps divergent perceptions and interests which can discourage the many concerned parties and prevent them from cooperating and collaborating. Traditional technical approaches seldom seek to reach an agreement among these conflicting interests. Instead, they resort to persuasion that is based on technical reasoning alone. The result is that they too often fail.

The FORWARD Project, which is concerned with "collaborative planning" and "consensus building," has focused for many years on the critical and sensitive issues related to water resources in the Middle East. It brings to the database needs assessment its awareness of the problem and the need to develop innovative participatory approaches. It insists on researching the convergence of ideas and collaboration between the concerned parties that will be directly involved: the ministries, the agencies in the basin, water users in the private sector, and the future river basin agency of Souss-Massa. Solutions can be developed through

understanding the needs of the available databases and searching for consensus among a large number of organizations. The challenges cannot be taken up unless the public organizations are willing to work together to meet the users' increasing needs, both current and future, and protect the sustainability of the resource, which is at great risk.

CHAPTER 2
PARTNERS IN THE WATER SECTOR

Partners in the water sector are numerous but one can differentiate each party by its attributions. The Higher Council for Water and Climate (CSEC) and the National Council for the Environment (CNE) are consultative organizations entrusted with formulating the general orientations of policy on water and the environment respectively. CSEC has already convened ten times and addressed topics of wastewater reuse and water economy in agriculture, among others.

Four main administrative organizations are directly concerned with water policy at the national level. They are: the General Directorate of Hydraulics (DGH), a department of the Ministry for Equipment; the Administration of Agricultural Engineering of the Ministry for Agriculture and Fisheries (AGR); the National Office of Drinking Water (ONEP); and the Secretariat of State in charge of the Environment (SEE). In addition to this core, there is the Ministry for the Interior; the Ministry for Industry, Trade and Handicraft; and the Ministry for Public Health.

The regional organizations concerned with water represent the central government departments. These organizations are generally entrusted with implementing the policies decided in Rabat. With the advent of decentralization, dependence is yielding ground to some perceptible autonomy. The functions of the regional organizations remain, however, almost identical to those of the central administrations. The duties of each of these regional organizations are summed up in the following paragraphs.

Regional Directorate of Hydraulics (DRH)

This directorate is responsible, among other things, for implementing all the central decisions concerning the area. Part of the General Directorate of Hydraulics, it contributes to the planning, mobilization, management, and quality of water resources in the area. It is also in charge of the management of large hydraulic works and the allocation of drinking water and agricultural water. The quota system used as a basis of this distribution takes into account the available water resources and priority needs. While the management of mobilized surface water is under control, ground water is relatively more difficult to manage. The deficit observed at the aquifer level, which is worsening, is indeed the result of overexploitation. In accordance with article 20 of the Water Law, most of the responsibilities of the DRH will be transferred to the river basin agency whose board of directors is chaired by the Ministry for Equipment as stipulated by the article. The DRH has of a network of monitoring sites and a regional laboratory.

Regional Office for the Agricultural Development of Souss-Massa (ORMVA-SM)

This office is a parastatal organization responsible for water resource management in the agricultural sector in the Souss-Massa river basin. Its principal responsibilities are the planning of hydraulic infrastructures, the management and maintenance of the irrigation networks and technical equipment, and cost recovery in the irrigated perimeters. ORMVA-SM has extension capabilities to ensure that farmers adopt efficient irrigation techniques. ORMVA-SM coordinates the actions of the

Administration of Agricultural Engineering pertaining to the development and the management of hydraulic facilities.

National Office of Drinking Water (ONEP)

ONEP is a para-statal organization in charge of production, treatment, and distribution of drinking water nationally. It is responsible for monitoring and improving water quality and controling water pollution. ONEP developed directives ensuring the quality of drinking water. These directives, which are in conformity with the provisions of WHO, were set up as national standards. This organization plays an increasing role in the field of sewage, particularly in small and medium sized centers, in accordance with the recommendations of the Higher Council of Water and Climate.

Secretariat of State in Charge of the Environment

This department, currently represented locally within the Delegation of Housing and Urbanization, coordinates government activities related to environmental protection. It currently pilots several projects in the field of water and endeavors to set up standards for emissions. The project of wastewater recycling carried out in the commune of Drarga, with funding from USAID, is a pilot project that could be reproduced in other communes or villages.

Agadir Autonomous Multiservice Agency (RAMSA)

RAMSA is a parastatal organization with financial autonomy. It is in charge of the distribution of drinking water and sewage management in the urban center of Agadir. It is in charge of the maintenance of drinking water and sewage networks, domestic wastewater treatment, and disposal. RAMSA bills users using three tariffs according to the amount of water used; it is also in charge of the cost recovery. Each user must abide by the specifications stipulated in the contract signed with the agency. RAMSA recently introduced a fee for sewage services, based on the quantity of drinking water consumed. It is billed to the user at the same time as the water consumption bill.

Regional Representation of the Ministry for Public Health

This agency carries out the directives of its department on the regional level. It is in charge of sanitation and of ensuring that water resources used by the public are safe for drinking and bathing. It monitors water quality at different water sites in rural areas. The scale of these actions depends on the means allocated to this kind of activity. The Regional Representation of Public Health has a laboratory where it conducts microbiological analyses.

Representation of the Ministry for Industry, Trade and Handicrafts (MICA)

This organization carries out the directives of its department on the regional level. It endeavors to set up a database on industrial activities in the area. The Ministry takes part in drafting legislation on monitoring industrial effluents. The department is

concerned with disseminating best practices for the use of industrial waters and developing a databank on industrial effluents.

Professional Chambers and Users Associations

Members of the Chambers of Agriculture, Trade and Industry are elected by professionals from each branch. Apart from these official professional organizations, Souss-Massa has a plethora of associations created around a profession, an action, or a theme. These include associations of water users; associations of the exporters of agricultural produce like the APEFEL (Trade Association of Exporters of Fruit and Vegetables); and associations of the professionals of tourism: the GRIT (Inter-professional Grouping of Tourism). These professional organizations represent water user groups.

Cooperation Platform for Partners

Major assets can be used to launch a cooperative effort among partners to create harmonized databases and manage water resources in the area in an integrated way. All the organizations dealing with water management are government departments, which must act in the public interest and respect, in the spirit and the letter, all the provisions of the law on water.

CHAPTER 3
DESCRIPTION OF CURRENT WATER RESOURCE MANAGEMENT DATABASES

General Directorate of Hydraulics

The General Directorate of Hydraulics developed a database system for water resource management called BADRE21. The five parts that make up this system concern dams, hydrometric stations, boreholes/wells/streams, water quality, and rainfall/climatology. Each part consists of modules and sub-modules as described below.

Database settings: By using modules and the appropriate rubrics, BADRE21 makes it possible to add or update:

- Basic data related to the administrative zoning and other geographical divisions based on the areas, hydraulic basins, and sub-basins.

- Information about the pre-established lexicons and the "natural entity" of each water point and outlet.

- Information about the settings of the water quality data and the users, which allows for adjustments of quality, piezometry, and rainfall after the database has been created.

Site reports: This module makes it possible to update information about a particular water point.

Reports on measurements: This part has been constructed in such a way as to use the relationships established between modules. The editing is thus carried out in an interactive and user-friendly manner.

Hydrology: This module allows, among other things:

- The storage of data about batteries, scale tables, calibration curves, water depth, calibrations, tilted scales, and flow.

- The calculation of sudden flows, daily flows, monthly statistics, and the processing of the hydrological directory.

Solid transportation: This module makes it possible to store data about solid transportation and to calculate the monthly statistics and the processing of the hydrological directory.

Management of dam water storage: This module allows, among other things:

- To enter data related to dams, reservoirs, restitution works, downstream water facilities and any other data concerning the dams.

- To calculate the monthly statistics and water resource balance sheet.

Data transfer: This module makes it possible to transfer data between DRH and DGH in both directions.

Editing: This module makes it possible to publish worked-out data under Excel or a built-in program.

The descriptive elements of this system are presented in Table 3.1.

Table 3.1 Description of the General Directorate of Hydraulics Database System, BADRE21

Database Identification	Description	Objectives	Parameters	Hardware/Software	Networks
Water resources database for the 21st century	This database has been constructed since 1995. Structured in five parts, it is fed textual and raw numerical data. DRH feeds information to DGH and the worked-out data can take the opposite direction. Parts of the database relate to commercial water, the management of dams, drinking water supply in rural and other areas. The database is now operational on a centralized level. The Regional Management of Hydraulics of Agadir will receive the necessary equipment to install the database by the end of 2000.	Used as an integrated water resource management tool. The evolutionary and relational data base is used to supervise, monitor and manage surface and groundwater .	• Technical specification of structures • Hydraulical balance • Measured flows • Exploitation capacity of wells and boreholes • Piezometric level • Principal Indicators of pollution • Physico-chemical analysis • Total and fecal coliforms • Rainfall and climatic data • Financial data • Others	• High-performance computer equipment, personal computers, workstations • Risc 6000, IBM H 70,Unix Aix • Exploitation system: Unix, Windows95/98/NT • DBMS: Oracle8/Access • GIS: ArcInfo/ArcView16 Licences	• Networks between the various departments of DGH • Intranet networks between DGH and DRH

Regional Directorate of Hydraulics

The data collected within DRH are classified according to either the water facilities or the activities of the management. The six databases relate to dams, hydrometric stations, boreholes/wells/streams, modflow, quality, and rainfall/climatology. The summary description of each database is presented in the following paragraphs:

Database on dams: Contains information related to hydraulic works and quantitative information that make it possible to establish the water balance sheets. It thus makes it possible to manage the mobilized water resources.

Database on the hydrometric stations: Contains information relative to each station and the values measured such as the flows. It makes it possible to compute the hydraulic potential of the basin.

Database on boreholes, wells and streams: Contains information relative to each borehole along with values such as exploitation flows and piezometric levels. It presents the state of the water table and allows a determination of the potential for withdrawal.

Database on water quality: Contains the qualitative data of mobilized water, surface water and groundwater. These data makes it possible to assess the situation and follow changes in water quality in the basin.

Database drawn from the Modflow mathematical model: This model is a tool that simulates hydrodynamic basin water tables. It is used to forecast the hydrological situation by evaluating the level of the water tables and its variations according to intakes and withdrawals.

Database on rainfall and climatology: Contains data about rainfall, wind speed, evapotranspiration, and temperature.

The descriptive elements of these databases are synthesized in Table 3.2.

Table 3.2 Description of the Regional Directorate of Hydraulics Database

Database identification	Description	Objectives and update frequency	Parameters	Hardware/Software	Networks
Dams	Information relating to the work and quantitative data .	• Management of mobilized water resources. • Regular collection of information.	• Technical specification of the structure • Hydraulic balance sheet	• Personal computers • Exploitation systems: Windows 95/98 • Software: Excel/Access • Specific software: Modflow Model for the study of water table hydrodynamics	Intranet network between the regional and central administrations.
Hydrometric stations	Information related to each station and the measured dimensions.	• Accounting of hydraulic potential of the basin. • Regular collection of information.	• Technical specification of the station • Measured flows		
Boreholes, wells, streams	Information related to each borehole and the measured dimensions.	• Knowledge of the state of the water table and the water potential for extraction. • Regular collection of information. • Unidentified works are not included in this collection.	• Technical specification of the structure • Exploitation flow • Piezometric level		

Table 3.2 Description of the Regional Directorate of Hydraulics Database (cont.)

Database identification	Description	Objectives and update frequency	Parameters	Hardware/Software	Networks
Water quality	Qualitative data on mobilized water, surface and groundwater	Water quality monitoring in the Souss-Massa and Tamri-Tamaraght basins. Regular but not generalized collection of information	• Major pollution indicators • Physicochemical analysis • Total and fecal coliforms		
Modflow model	A tool for the simulation of water table hydrodynamics	Hydrogeological forecasting	Inputs: Characteristics of the water table Outputs: Level of the water table, variations and velocity		
Rainfall and climatology	Data related to rainfall and climatology	Statistics and draft records	• Rainfall • Temperature • Wind velocity • Evapotranspiration		

Regional Office for the Agricultural Development of Souss-Massa

To improve the use of irrigation systems, the Regional Office of Agricultural Development developed a computerized instrument entitled "Gestion des usagers du Souss Massa" (Souss-Massa Users Management). This management and information system was created using Microsoft Access 97 to ensure the management of distributed volumes of water, to generate the bills, and to follow-up payment. This database contains information on the hydraulic and land tenure structure of the perimeter, the irrigation parameters, information about water users, the contracts signed with the office, water consumption of each user, and the billing parameters.

The ORMVA-SM has another database concerning wells and boreholes. More than 12000 items are processed using Access. It also contains references to the works, the authorized intake and the annual water withdrawal rate. The ORMVA-SM is the coordinating organization of the commission made up of the local authority and the Regional Management of hydraulics that grants permission for the digging and management of wells. The ORMVA-SM is about to launch a general investigation to update this database.

The summary of the descriptive elements of these databases is presented in Table 3.3.

Secretariat of State for the Environment

SIDE (Information and Data System on the Environment) is being designed. The originality of this system lies in the partnership that supplies the data. The organization and collaboration between SIDE partners could be further exploited in such fields as the integrated water management.

The descriptive summary of this system is presented in Table 3.4.

Table 3.3 Description of the ORMVA-SM Databases

Database identification	Description	Objectives and update frequency	Parameters	Hardware/Software	Networks
Boreholes and wells	Information about the structure and the authorized withdrawal rates.	Ensures monitoring	• References • Authorized withdrawal rates • Annual withdrawal rates	• Personal computers • Software: Excel, Access	No networks among the various departments in this office
Management of the Souss-Massa water users	Serves as a support for all actions related to water and conducted by the office in the perimeter.	Ensures the management of water users, water distribution, billing and follow-up on payments due.	• Land tenure and hydraulic structure • Irrigation parameters • Information about water users • Contracts between water users and the office • Water consumption by each user • Billing parameters	• Personal computers • Software: Excel, Access	

Table 3.4 Description of the SIDE Database System

Database identification	Description	Objectives and update frequency	Parameters	Hardware/Software	Networks
SIDE	An ambitious system being designed to use the information collected through the Network of Active Partners in Information and Data Concerning the Environment (Réseau des Acteurs Partenaires en Information et Données sur l'Environnement: RAPIDE). The aim is to use it as an integrated database.	Could be used to generate reports on the status of the environment in Morocco and simulated scenarios on the impact of the socio-economic development on the environment	Broad spectrum of parameters describing the activities of partner departments such as the Environment, Equipment, Agriculture, Health, Industry, etc.	• An entire GIS station, a license, several personal computers • Environment: Windows 95/98	Undefined

National Office of Drinking Water Regional Databases

The information collected by ONEP on a regional level is classified according to its nature (qualitative or quantitative) in order to meet the needs management planning. The data collected during the monitoring of drinking water in the ONEP networks are entered and presented in the databases. Likewise, the flows measured upstream and downstream and the results of the analyses carried out to evaluate the pollution potential are integrated in the databases files. Currently, these databases are used to:

- Control and monitor the quality of the water produced by the ONEP;
- Identify and monitor pollution sources which are likely to affect the quality of drinking water;
- Plan, carry out, and manage the drinking water and sewage networks.

The frequency of the withdrawals is regular. The ONEP has a regional laboratory for water analysis. The ONEP laboratories in Rabat and the Public Health laboratories in Agadir are also used. To assure good, sampling and tests are carried out according to a schedule set up by the office. The descriptive elements of the databases are presented in Table 3.5.

In addition, there are communes where the inhabitants provide their own basic infrastructure. In these communes, provisions of water and management of the distribution of the potable water is assured by organizations created for this purpose. Tens of communes have taken it upon themselves to build infrastructure (water towers, distribution networks) and manage water distribution among their residents. The commune of DRARGA not only takes charge of water conveyance but also works closely with the PREM project to treat and reuse its wastewater for agricultural purposes.

National Office of Drinking Water Centralized Information System

The SIONEP information system was designed to match the strategic objectives of ONEP. This system integrates ONEP applications such as planning, exploitation, and management. Its implementation ensures a high performance water supply, improves the quality of products and services and strengthens decentralization through a good information flow. The summary description of this system is included in Table 3.6.

Table 3.5 Description of the ONEP Regional Databases: ONEP Agadir

Database identification	Description	Objectives and update frequency	Parameters	Hardware/Software	Networks
	Data collected during monitoring of drinking water in the ONEP network are entered and presented in the form of databases. Flows measured upstream and downstream of the network form part of this database. For sewage, measurements taken to evaluate pollution potential are integrated in the files presented in the form of data bases	• Better monitoring of the quality of the water produced by ONEP. • Identification and monitoring of sources of pollution. • Obtaining statistical data. Regular sampling according to a schedule set up by the office.	• Qualitative parameters of a microbiological and physicochemical nature • Flows at various levels.	• Personal computers • Operating system: Windows 95/98 • Software: Excel/Access Eventually the SIONEP information system will integrate the data and the models.	Network between the regional office of ONEP and the headquarters in Rabat

Table 3.6 Description of the ONEP Centralized Information System: SIONEP

Database identification	Description	Objectives and update frequency	Parameters	Hardware/Software	Networks
ONEP Information System	Designed to implement a complete and open range of integrated and evolving applications for all the functions of ONEP: • Planning and equipment • Exploitation and buying • Accounting and financial department • Human resources • Decisional • Other applications	Designed to match the strategic objectives of ONEP, namely: • Ensure a high performance water supply • Extend the activity to the level of the small centers and diversify the activity towards sewage and waste water recycling • Improve the quality of services and products • Monitor management and costs • Strengthen decentralization	Information necessary to the good management of the office: financial, technical, technological, land, and others	Powerful data processing equipment: • Personal computers • Workstations • Operating system: Unix, Windows 95/98/NT • DBMS: Informix/Oracle/Access • GIS: ArcInfo/Star	Interconnection of all the entities of ONEP by a backbone network and local area networks

Regional Representation of Public Health

Considerable efforts have been made by the regional representation of Public Health to develop an epidemiology observatory and monitor environmental hygiene. The databases resulting from these efforts are described in what follows.

The database on environmental hygiene contains the results of tests carried out on drinking water in the networks of ONEP and RAMSA and the results of tests carried out on wastewater, water points in rural areas, and swimming pools. This qualitative database makes it possible to better monitor the quality of water supplying the urban and rural centers and to better monitor the sources of pollution and infection. The database is updated irregularly. The frequency of sampling is generally dependent on the means allocated to this activity.

The database of the epidemiology observatory is the final link of a network which collects and transmits information to the observatory. All information on diagnosis, place and date of outbreaks, and deaths are indexed. Infectious diseases are reported and indexed the same day while other diseases are entered on a monthly basis. From this database, it is possible to extract a file that could be referred to as a monitoring board tool, which would represents the epidemiological situation of the area on a daily basis.

This description is included in Table 3.7.

Agadir Autonomous Multiservice Agency

The data collected by RAMSA are indexed in files classified according to their nature (qualitative or quantitative) to meet the needs for RAMSA management planning. The data collected during the monitoring of drinking water in the RAMSA network are entered and presented in a file. Household consumption and tariffs are computed in other files. The flows measured upstream and at the interface with ONEP are also indexed. For sewage, certain measurements made on wastewater give values which are also entered.

Added to drinking water controls established by ONEP and the Delegation of the Ministry of Health, RAMSA puts great emphasis on monitoring the quality of water resources. RAMSA has contracted a private company (ELYO) to monitor and analyze water on a regular basis. ELYO will monitor water resources systematically according to contractual agreements by sampling and laboratory tests. The sampling program is scheduled by RASMA.

This description is included in Table 3.8.

Regional Representation of the Ministry of Industry, Trade and Handicrafts

No database has been identified at the representation of the Ministry for Industry, Trade and Handicrafts. Like energy, water is a production factor which should be monitored. MICA should have statistics so it can inform investors and make industrialists aware of water saving techniques. Industrial water consumption and the

characteristics of fluid effluents are data necessary to any water resource management program in the area.

Table 3.7 Description of the Regional Representation of Public Health Databases

Database identification	Description	Objectives and update frequency	Parameters	Hardware/Software	Networks
Environmental hygiene	Entered and presented in the form of databases: results of the tests carried out on drinking water in the networks of ONEP and RAMSA on wastewater, water points in the rural areas and swimming pools.	• Monitor the water quality supply of urban and rural centers • Identify and monitor pollution sources • Obtain statistical data Sampling according to needs. Frequency is irregular.	Qualitative parameters of a microbiological and physicochemical nature	• Personal computers • Exploitation system: Windows 95/98 • Software: Excel/Access • Specific software: Epi-Info under Access	Networks among the various services of the representation: the observatory, the service of environmental hygiene, and the regional coordinator Intranet network between the representation and the central administration.
Epidemiology	The epidemiology observatory of the area of Souss-Massa-Draa is being set up around a simple but essential database. Waterborne diseases are among the cases indexed.	Provide information to the observatory which monitors the epidemiological situation of the area. Epidemiological diseases are indexed the very same day whereas other diseases are entered monthly.	• Information on diseases diagnosed along with place and date • Deaths • Statistics	• Personal computers • Exploitation systems: Windows 95/98 • Software: Excel/Access • Specific software: Epi-Info under Access	

Table 3.8 Description of the RAMSA Databases

Database identification	Description	Objectives and update frequency	Parameters	Hardware/Software	Networks
RAMSA	Data collected during the monitoring carried out on drinking water in the networks run by the RAMSA are entered and presented in the form of databases. Household consumption and flows measured upstream, and at the interface with the ONEP are part of this database. For sewage, measurements on waste water give values reported in this data base	• Improve monitoring of the quality of urban water supply • Identify sources of pollution • Obtain statistical data. The frequency of sampling is regular. RAMSA has commissioned a private company to take care of the sampling and tests according to a schedule.	• Qualitative parameters of a microbiological and physicochemical nature • Flows at different levels	• Personal computers • Software: Excel	None

CHAPTER 4
DIAGNOSIS OF CURRENT WATER RESOURCE MANAGEMENT DATABASES

Four principal criteria are used to diagnose the databases of the various organizations: the choice of parameters, architecture, the data processing support (hardware and software), and the frequency of the updating of the data.

General Directorate of Hydraulics: BADRE21

BADRE21, an integrated and relational database, is designed to meet the needs of the General Directorate of Hydraulics as well as those of the Regional Directorates of Hydraulics as regards water resource management. This system is equipped with a module which makes it possible to transfer the data entered by DRH to DGH and back to DRH.

Given that this system appears to be high performing, we focused on its implementation at the central and regional levels. We noted that the process requires human and material resources. The transfer of the data of the previous database to BADRE21 will be time consuming because of the amount of information to be transferred. Likewise, the use of BADRE21 to create a regional database such as that of Souss-Massa will require mastery of the instrument, on the one hand, and acquisition of appropriate data processing equipment at the regional level on the other hand. The willingness shown by the decision-makers of this Directorate suggests that the two prerequisites will be met in the short term.

The transfer of the data between the DGH and DRH is, for the time being, a two way process. A one way path transfer of the information could be envisaged in the future. Once the regional database has been implemented, the transfer towards the Central Directorate will involve the elements of this very database.

The diagnosis components are reported in Table 4.1.

Recommendation: The only recommendation which we deem important is to speed up the transfer of BADRE21 to the DRH in Agadir by acquiring the necessary equipment and organizing training programs to enable the local staff to master the system.

Table 4.1 Diagnosis of the General Directorate of Hydraulics Database BADRE21

Database identification	Assets and observations	Limitations and constraints: functional aspects	Future needs	Parameters	Hardware and equipment	Software and actions
BADRE21	Integrated and relational database using appropriate information processing	• Transfer of data from the previous database to BADRE21 will be time consuming. • Complete and perfect retrieval of a regional database such as that of Souss-Massa will require mastery of the instrument and risks being slow. • Centralized information flow: to strengthen decentralization, the regional database must feed information into the central database.	Implementation of BADRE21 for the Agadir DRH	To make this system a powerful decision-making instrument, include data related to the use and the consumption of water available in the ORMVA-SM and ONEP databases.	Everything has been planned in the BADRE21 implementation project	Everything has been planned in the BADRE21 implementation project

Regional Directorate of Hydraulics

The six databases identified by DRH have the advantage of being complete. The parameters included in each database meet the needs of DRH. Some limitations have been observed. On the architectural level, and in spite of their intrinsic qualities, the databases are not structured in an integrated way. The presentation in the form of independent files limits the use of these databases. Likewise, the data processing equipment intended for database management is limited in execution and storage capacity. The software used is Excel under the Windows environment. The version of Modflow, a computational tool which transforms raw data into processed data, could benefit from recent data processing developments: interactive menus, inputs importation, graphic interfaces. As for the reliability and representativeness of the data, DRH has a program for data collection which is processed systematically. The collected data are sent to the national database on water resources in Rabat.

A summary of the diagnosis is included in Table 4.2.

Recommendations: The recommendations drawn from the diagnosis are as follows:

- Improve data gathering by automation and development of telemetrics.
- Harmonize data collection and testing methods with other partners.
- Accelerate the transfer of BADRE21 pending the creation of the agency of the Souss-Massa basin. BADRE21, a modular database, fully meets the needs of DRH.
- Provide sufficient hardware and software to install BADRE21.
- Introduce a new user-friendly and interactive version of Modflow integrating the capacities developed recently to facilitate the handling of the inputs and the reporting of the outputs. Modflow is a mathematical model designed to simulate the hydrodynamics of the water table in the basin. It is used to predict the hydrological situation by evaluating the level of the water table and its variations according to its intakes and outflows.
- Schedule training programs in information systems and data processing for databases.

Table 4.2 Diagnosis of the Regional Directorate of Hydraulics Database

Database identification	Assets and observations	Limitations and constraints	Future needs	Parameters	Hardware	Software and actions
Database related to structure	Availability of a high amount of information	Static Non relational	A database structured in modules would allow for better water management. The short-term transfer of BADRE21 is an ideal solution.	Data on water table samples	Equipment to install BADRE21	Software utilities for BADRE21

Regional Office for Agricultural Development

The ORMVA database on user management is exploited primarily for billing and recovery of the bills. Data such as water consumption, evaluated needs for water, and further information are included in the database but not processed; they could provide information on the efficiency of supply, distribution, and use of water in the perimeter. Agro-climatic parameters which could help the users better manage their water consumption are not available. With regard to architecture, the database is coherent, open, and able to integrate other modules. The data processing equipment intended for database management is currently sufficient. However, the introduction of equipment with a high storage and execution capacity improves the effectiveness of the system. The use of Access is compatible with the architecture of the ORMVA database.

As for the reliability and the representativeness of the collected data, ORMVA has a program of data collection that is run systematically. Some data should be collected through remote measuring procedures. Automated data collection allows for objective data collection in real time. To better manage the resource, the database should include a module that provides water use yields for each node and plot in the network

The database on wells and boreholes requires updating.

The summary of the diagnosis is presented in Table 4.3.

Recommendations: The following recommendations are drawn from the database diagnosis:

- Improve data gathering by automation and the development of remote measuring.
- Harmonize the analysis and data gathering methods with the other partners.
- Design an appropriate database for wells and boreholes.
- Design a module that will be used as a monitoring tool for irrigation management in the Souss-Massa perimeter. This tool would enable the persons in charge of the office to obtain, in real time, relevant information on water loss, water distribution efficiency, and water use in field plots.
- Install other meteorological stations in areas representative of the perimeter and the data collecting system.
- Provide equipment to supplement adequate hardware and software: Pentium III personal computers, a provider, Access/Oracle, GIS.
- Install a data processing network among the departments of the office and between the office and its other entities in the perimeter.
- Schedule training programs in information systems and data processing for databases.

Secretariat of State for the Environment

The SIDE information system is very ambitious. Its implementation will require important hardware and human resources.

SIDE was to be developed and tested for a specific area before extrapolating it to all Morocco. This procedure would make it possible to determine the problems specific to each area. The area of Souss-Massa could be used as the venue for a pilot SIDE.

The summary of the diagnosis is presented in Table 4.4.

Table 4.3 Diagnosis of the ORMVA-SM Database

Database identification	Assets and observations	Limitations and constraints	Future needs	Parameters	Hardware and Equipment	Software/ Actions
Souss-Massa Users Management Database on wells and boreholes	Meets the present needs of the office User-friendly software	Limited exploitation of the database. It is not possible to draw worked out data such as the efficiency of water distribution and use in the perimeter and that enables the office to evaluate the water saving potential. The database on wells and boreholes requires an update of the architecture and the parameters.	• Design a database on wells and boreholes • Equip the perimeter with additional agro-climatic stations to generalize the use of the "total solar radiation" coefficient in the irrigation programs • Introduce a module to establish a hydraulic balance sheet for each irrigation network • Strengthen data collection in the field to improve and refine quantification of needs in irrigation water, • Introduce GIS to visualize and interpret the data	• Agroclimatic parameters to obtain total radiation in the perimeter • Parameters necessary to computate the efficiency of water distribution and its use in the perimeter • Parameters related to the exploitation of wells and boreholess.	• Equip the perimeter with agro-climatic stations • Introduce telemetry into information collection	• Oracle • GIS

Table 4.4 Diagnosis of the SIDE Database

Database identification	Assets and observations	Limitations and constraints: functional aspects	Alternative	Parameters	Hardware and equipment	Software and actions
SIDE	Ambitious Based on the Network of Active Partners in Information and Data Concerning the Environment (RAPIDE)	• Success depends on the coordination of RAPIDE. • No convention or memorandum has been defined as a basis for partnership between actors. • A considerable effort is necessary to inventory all the available data at the national level. • Validity of the system is difficult to achieve because of its complexity; • Piloting of SIDE requires a competent multidisciplinary team.	SIDE was to be developed and tested in one area prior to its extrapolation all over Morocco. This procedure would reduce the constraints mentioned above. It has the advantage of determining the problems specific to each area. Souss-Massa could be used as a SIDE pilot site.	To be defined	To be defined	To be defined

ONEP Agadir Regional Management

The data collected by ONEP meet its current management and planning needs. The existing databases are presented in the form of static files which makes any subsequent classification and interpretation of information difficult. The data processing equipment intended for the management of the databases is limited as regards to execution and storage capacities. Excel under Windows environment is the most widely used software. Access is also available but is used less widely used. ONEP has a program of data collection that is used systematically. The collected data are sent to the national database in Rabat which is used in the management and the planning of drinking water and sewage all over Morocco.

The summary of the diagnosis is presented in Table 4.5.

Recommendations: The following recommendations are drawn from the database diagnosis:

- Pending the launch of SIONEP, the information system designed at ONEP headquarters in Rabat, ONEP Agadir needs a simple and evolutionary modular database that will feed a management module reporting relevant information on the supply, consumption, and quality of water.

- Provide additional hardware and software: Pentium III personal computers, a server, Access/Oracle, GIS.

- Install a data processing network among the departments of the office.

- Schedule training programs in information systems and database operation.

- Harmonize data gathering and methods of analysis with other partners.

Table 4.5 Diagnosis of the ONEP Agadir Database

Database identification	Assets and observations	Limitations and constraints	Future needs	Parameters	Hardware and equipment	Software and actions
ONEP Agadir database		Static Non relational	The information collection program meets the needs identified by ONEP. It is still necessary to have a module structured database capable of generating automatically worked out data to use in decision-making. Currently, the collected data are sent to the national database in Rabat. The database must provide information on the quantities and the quality of water carried over the ONEP network, loss and yield, specific consumption of drinking water, and the marginal cost at the outlet of the network. For a possible exchange of information, software commonly used for databases is recommended. For good spatial visualization, a GIS instrument is desirable.	The parameters currently measured and entered are sufficient.	• Central unit • Pentium III personal computers • A provider	• Access and Oracle • GIS

Regional Representation of Public Health

The module of the database on epidemiology is designed to meet the needs of the observatory. It accounts for epidemiologic diseases recorded up to the time of the consultation, but it is unable to provide information concerning their causes or their speed of propagation in time and space. This will only become possible when the module is enriched with relational functions enabling it to integrate the environmental, geographical, meteorological, and socio-cultural data from the area.

The module pertaining to environmental hygiene is composed of independent files that are able to provide, in a discontinuous way in time and space, reports on water quality and the environmental situation. This module would gain in reliability if the information on water quality and the environment were collected on a regular basis.

The database must be designed in such a way as to feed useful information into the epidemiology observatory and the departments in charge of drinking water conveyance.

The data processing equipment used in the management of these databases has limited execution and storage capacities. The software used is Access and Excel under Windows environment

The summary of the diagnosis is reported in Table 4.6.

Recommendations: The following recommendations are drawn from the database diagnosis:

- Design a modular and integrated database. Three modules are suggested : a general module would serve as a library for general geographic and socio-cultural information; another module would be concerned with environmental hygiene; the last module would be for epidemology. The integration of these three modules in a single database will facilitate information exchange among the modules.

- Design a module to serve as a monitoring board tool for regional health and hygiene conditions, especially in the rural environment.

- Provide additional hardware and software: Pentium III personal computers, providers, Access/ORACLE, GIS.

- Consolidate the information processing network among departments within the representation.

- Schedule training programs in information systems and database operation.

- Harmonize data gathering and methods of analysis with other partners.

Table 4.6 Diagnosis of the Regional Representation of the Ministry of Public Health Databases

Database identification	Assets and observations	Limitations and Constraints	Future needs	Parameters	Hardware	Software and actions
Environmental hygiene	• Straightforward • Responsive to the needs of partial follow-up	Static Non-relational	Databases structured into modules. The program of data collection meets monitoring and prevention needs. The database should provide information on the causal effects between diseases and water. For future information exchange, commonly used software is recommended. Spatial visualization and the use of GIS instruments are desirable as well.	The parameters presently measured and stored are probably sufficient. However, the sampling areas are to be expanded both in time and space so that data can be representative and reliable.	• Pentium III personal computers • Provider	• Access and/or Oracle • GIS
Epidemiology	• Straightforward • Graphic illustrations of information • Allows sorting by types of disease, space, and time	Non-relational				

Agadir Autonomous Multiservice Agency

The data collected by RAMSA meets the current management and planning needs of the agency although the database design is not optimal. The databases are presented through independent files, which makes them difficult to use. The computer equipment used for database management has limited capabilities for storage and execution. Excel under the Windows environment is the most commonly used software. Access is available yet seldom used. RAMSA has a systematic data collection program. All the laboratory tests are assigned to a private firm. It is important to guarantee the relevance, reliability, and representativeness of the data.

The summary of the diagnosis is presented in Table 4.7.

Recommendations: The elements of the diagnosis carried out on the databases allow us to make the following recommendations:

- Design a modular and integrated database that meets the needs of RAMSA and feeds a module, which will serve as a monitoring board tool for water resource management in the network of the agency.

- Provide additional hardware and software: Pentium III personal computers, a provider, Access/Oracle, GIS.

- Install a computer network linking the departments of the agency.

- Provide training sessions in information systems and informatics in database management.

- Harmonize data gathering and methods of analysis with other partners.

Table 4.7 Diagnosis of the RAMSA Databases

Database Identification	Assets and Observations	Limitations et constraints	Future needs	Parameters	Hardware and equipment	Software and actions
	None	• Non-relational databases • Data spread out in independent files • Data management comparable with the archives • Impossible to sort the data • Difficult to calculate output	A full information system capable of serving as an instrument for better management of RAMSA. Water resource management should constitute a module within global management.	Current parameters should be upgraded by adding other parameters such as pollution indicators and distribution yield.	• Central unit • Pentium III personal computers • A provider	• Access and/or Oracle • GIS

Regional Representation of the Ministry of Industry, Trade and Handicrafts

Recommendations: The Regional Representation of the Ministry of Industry, Trade and Handicrafts should be equipped with a database on industrial water and wastewater to inform investors, develop water resource management strategies, and participate in the endeavor to reduce the regional water resource deficit. This database will be developed through:

- A simple, accessible and progressive design.

- Relevant parameters: consumption (global, specific, by each industrial sector); information about wastewater (characteristics, flow, pollution indicators); data and ratios to serve as a reference to set the objectives for water saving and environmental management.

- Required hardware and software: Pentium III personal computers, a provider, Access/Oracle.

CHAPTER 5
IMPROVEMENT OF INFORMATION SYSTEMS FOR INTEGRATED WATER MANAGEMENT

The management of a hydrological system is a set of actions, organized within a decision-making process, which aim to ensure a certain level of satisfaction of the water requirements for the economic and social sectors, compatible with sustainability of the resource and the quality of the environment. In Souss-Massa, water management is even more complex owing to the fact that it takes place in a context of structural deficit. Indeed, with a water deficit of 240 to 260 million m^3 a year, the challenges in Souss-Massa are crucial. They require a voluntary and participatory approach with two objectives: arbitration between the various conflicting needs, and identification of mechanisms to maintain the exploitation of water resources at an acceptable level.

To meet these challenges, which will be growing under the pressure of the various economic sectors, the actions to be carried out must be technical, institutional, financial and organizational. To contribute to this multidimensional effort, we undertook a study on the databases and needs for information systems to ensure an integrated management of the water resources and the decision-making. We identified proposals which consolidate the decision-making processes and the instruments. Subsequent to the diagnosis, we formulated nine recommendations which aim at improving the decision-making tools by developing operational and evolving databases and information systems, strengthening institutional capabilities, and creating participatory information sharing models. These proposals are presented in the following paragraphs.

A Manual on Harmonization

The number of actors/partners involved combined with the scarcity and varying quality of the resource make it extremely desirable to control all aspects of water management. Data are the key element to gaining knowledge of the resource in order to master state of the art decision-making. They are also important for modeling and simulation. This explains the interest and the need for a harmonized system of data collection. Now, each organization collects data to meet its own needs. The development of a harmonized approach to data collection will make better use of the efforts made by the various parties.

Harmonization would involve most of the procedures: data collection, measurement methods, organization, data structuring, and identification of the methods and opportunities for partial or total data exchange and data sharing. It allows for a better temporal and spatial representation of the water resources parameters monitored by all the agencies. In addition, it makes it possible to standardize the methods of collection, processing and exchange. It can ensure a more universal usage of the data. Data being necessary for any effort of modeling, simulation and of decision-making, it is important to have a consistent approach to measuring, collecting, organizing and structuring the data.

Harmonization makes it possible to formalize communication between the various organizations. Each service concerned files its information in an autonomous manner, which limits the usefulness of the collected information to that service. In the harmonized database system, with spatial reference for example, each service remains responsible for collecting, feeding, updating, and disclosing its information, but in a transparent manner the other services. The pooling of the data is facilitated, which allows for a greater regional integration and use.

It is recommended that a manual be drafted to harmonize data collection systems among partners. This manual will deal with the relevance of the collected data, their quality, their management, their representativeness, their storage, and the dissemination of comparable data in time and space. The fields of harmonization are:

- Monitoring water quality and water quantity
- Monitoring the state of the environment
- Observations of the environment and hygiene parameters
- Monitoring agro-meteorological parameters

At the operational level, the partners would:

- Ensure a better temporal and spatial representation of the water resource parameters monitored by various agencies. (A complete regional map would indicate all the sampling points, the parameters monitored, and the responsible agency. Such a concerted effort would make it possible to balance the regional water resources over the entire hydrological cycle to meet the needs of agencies and users. Complementary actions should be required and waste due to duplication of efforts should be reduced to assure coverage of the entire area and optimize the monitoring system and the sampling plan.)

- Standardize the data gathering protocols to facilitate exchange.

- Harmonize the methods of data analysis to facilitate the use of the data gathered by the various laboratories.

Automated Data Acquisition Systems

To improve the quality of the parameters collected, shorten the collection-use time lag of observations, and reduce data costs, it is recommended that telemetric systems be introduced or reinforced in the basin to monitor the quantitative and qualitative parameters of water resources. The objectives are as follows:

- Improve the follow-up on the quantitative and qualitative parameters
- Improve regional coverage of the observation sites
- Improve the quality and the number of collected parameters
- Shorten the collection-use time lag of the observations
- Provide real time access to the data
- Facilitate data transfer
- Cut down on data costs

The development of telemetric systems constitutes an indispensable arsenal to monitor the evolution of resources and consumption in real time and to better guide

the management of water resources, especially in case of scarcity. We propose the following six priority intervention areas to monitor:

- Surface water resources
- Groundwater resources
- Agricultural consumption in the modern perimeters
- Agricultural consumption in traditional irrigation perimeters
- Consumption for urban and rural domestic needs
- Meteorological parameters

The development of automatic stations makes it possible to monitor and regulate the volumes distributed to the various sectors of the irrigated perimeters and save water consumption by the networks and by agricultural and urban users, and it offers tools for managing the available resources. In the agro-meteorological domain, these stations provide data for hydrological simulations and facilitate the planning and the scheduling of irrigation. Similar telemetering networks and information exchange systems in operation in several parts of the world are a source of inspiration.

Sustainable Management of Groundwater Resources

Available studies show a continuous fall of the levels of the water table, which seems irreversible and threatens the sustainability of production systems in the area. It is vital to develop methods to monitor and manage the water table. This requires a better understanding. Currently, 12,500 wells are indexed by ORMVA and data concerning boreholes are available at DRH. These assets constitute a base that should be used, updated, and supplemented to develop a true database of intake points. To do this, we recommend a survey of all the wells and boreholes in the area to determine: the geographical situation of the point, authorized flow, real flow, authorized volumes, consumed volumes, piezometric levels, and water quality. The new and timely data will be a solid basis for the development of a groundwater database, used to optimize future decisions regarding ground and surface water management. Combined with simulation tools, this database will provide an indispensable decision-making tool. The monitoring of the rates of ground water depletion must be controlled through the following actions:

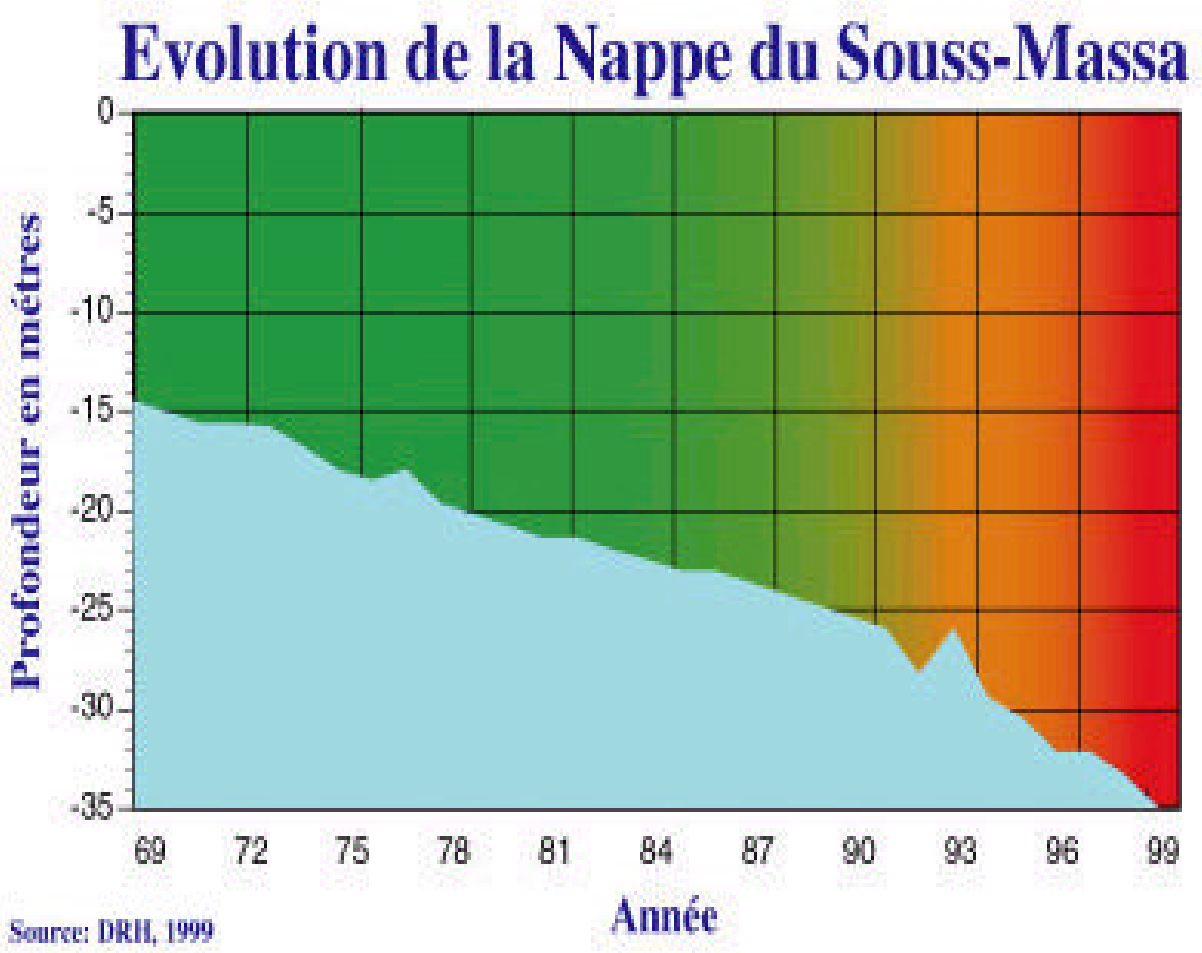
- A regional survey to establish an inventory of intake points: wells and boreholes
- A database to manage the aquifer: withdrawals, authorized volumes, consumption
- Reinforcement of the hydrogeological knowledge of the aquifers

On the basis of these tools and updated data, regulatory and tariff policies may be evaluated and applied in the near future.

Figure 5.1 Evolution of the Level of the Water Table

Sustainable Management of Groundwater Resources
Requires understanding, follow-up and management of the water table
The water should be managed as an economic commodity

The Figure 5.1 shows the decrease of water table (in meters) over the last thirty years.



Transfer of New Information Management Systems

The organizations and agencies involved in the planning, management, distribution, use, and protection of water resources have a wide range of systems and of databases to meet their daily needs. We have already proposed improvements for each database (see Chapter 3). In addition, the diagnosis showed that there are recent and powerful databases developed by DGH, ORMVA and ONEP. We recommend that the transfer and use of the following new and more powerful integrated databases be accelerated at the regional level:

BADRE21 Database

This new database is one of the recent creations of DGH. Developed under Oracle, it has powerful operational capabilities. To develop this great asset, DGH should be supported in:

- Accelerating the development of the database (equipment, base-line data).
- Transferring the database to the regional level and accelerating its use (equipment, training, basic data).

Management/Users Database

This database has been recently developed at ORMVA. It permits complete monitoring of water users and integrates a series of parameters to show water consumption, crop needs, and the historical record of the farmers. ORMVA should be assisted in accelerating the use and the development of this database and in later transferring it to the level of the subdivisions and CMV (ORMVA county offices = Centre de Mise en Valeur Agricole)..

ONEP Database

ONEP is currently developing an information system at the national level. The regional ONEP should adopt the national system with its open and flexible design.

Development of Geographic Information and Decision-Making Systems

To facilitate the use of the thousands of bits of data collected in the area and to build genuine computerized decision-making systems, we propose the introduction of a geographical information system. One of the principal components of information systems is related to the introduction of geographical information systems, designed to answer all questions that have a geographical implication. This computerized tool allows for the gathering, organization, management, analysis, combination, development, and presentation of geographically located information, contributing specifically towards the management of space.

A geographical information system is not limited to a passive storing of information. GIS allows for the processing of particular data as well as linking data of different nature or origins and checking an assumption. Thanks to appropriate semantics, namely forms and colors, GIS will constitute a tool for highlighting the characteristics of water resources in the area and will facilitate decision-making.

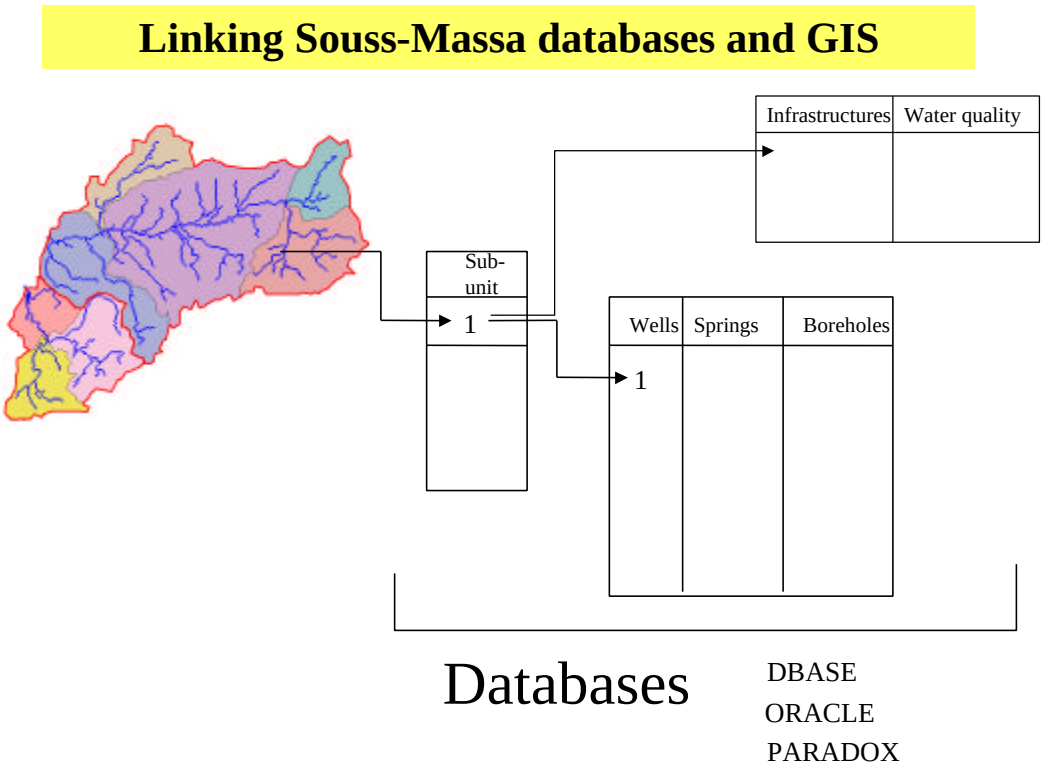
The proposed GIS must be able to:

- Produce maps on water resources, consumption, state of the environment
- Generate maps rapidly and set up interactive spatial choice processes
- Integrate data from different sources into the same system
- Enter data and react promptly to events or disasters which affect the territory

We recommend that a GIS be set up in the region. This would require a detailed investigation to identify the best alternatives to introduce to make its assets available to regional and national institutions. In this respect, we propose to develop a GIS at the SWIM project and transfer and adapt it for the BADRE21 database, the Management/Users database and the ONEP, RAMSA and Public Health databases.

The design of the GIS may prove to be an excellent area for negotiation and co-ordination. The design process must be appropriate accordingly. To ensure sustainability, we recommended a comprehensive training program that provides all partners, including the projected agency for the basin, with well-trained personnel. We also recommend transferring the GIS system developed for the USAID/Tadla project, adapting it for Sous-Massa. The achievement of the Tadla project shows that there are tools for resource management, especially water, which have been tested and used in Morocco. The GIS system is completely mastered and used by the staff of ORMVA-Tadla. This is an excellent example to follow since sustainability is assured. The tools continue to be used to improve water resource management beyond the end of the USAID project.

Figure 5.2 A Geographic Information System case



Development of an Information and Management System for Future Needs

The project must remain interactive and open to the future to meet the needs of partners of the project and the projected agency for the basin. One way of meeting the management needs of the projected agency would be to design an information and management system. This system should be seen as a tool for the organizational and financial management of the agency for the basin. In addition to the quantitative aspects related to water resources, the information system must be a management tool and ensure the interfaces with the agency's partners and customers (financial aspects and accountants).

Creation of an Observatory of Water Resource and Future Needs Management

The partners have a long-standing experience of collaboration. Given the extent and the urgency of the issues raised for a sustainable management of water resources, it is recommended that exchanges among partners be strengthened and formalized. A total integration of the information systems currently in use would not be realistic due to the diversity of the systems and of the habits of the users. It would, however, be appropriate to set up a dynamic mechanism that would reduce the constraints and difficulties related to information exchange. We propose the creation of an observatory of water resources (ORE) in the Souss-Massa basin that would be referred to as Information Exchange Network – Réseau d'Echange d'Information (ORE).

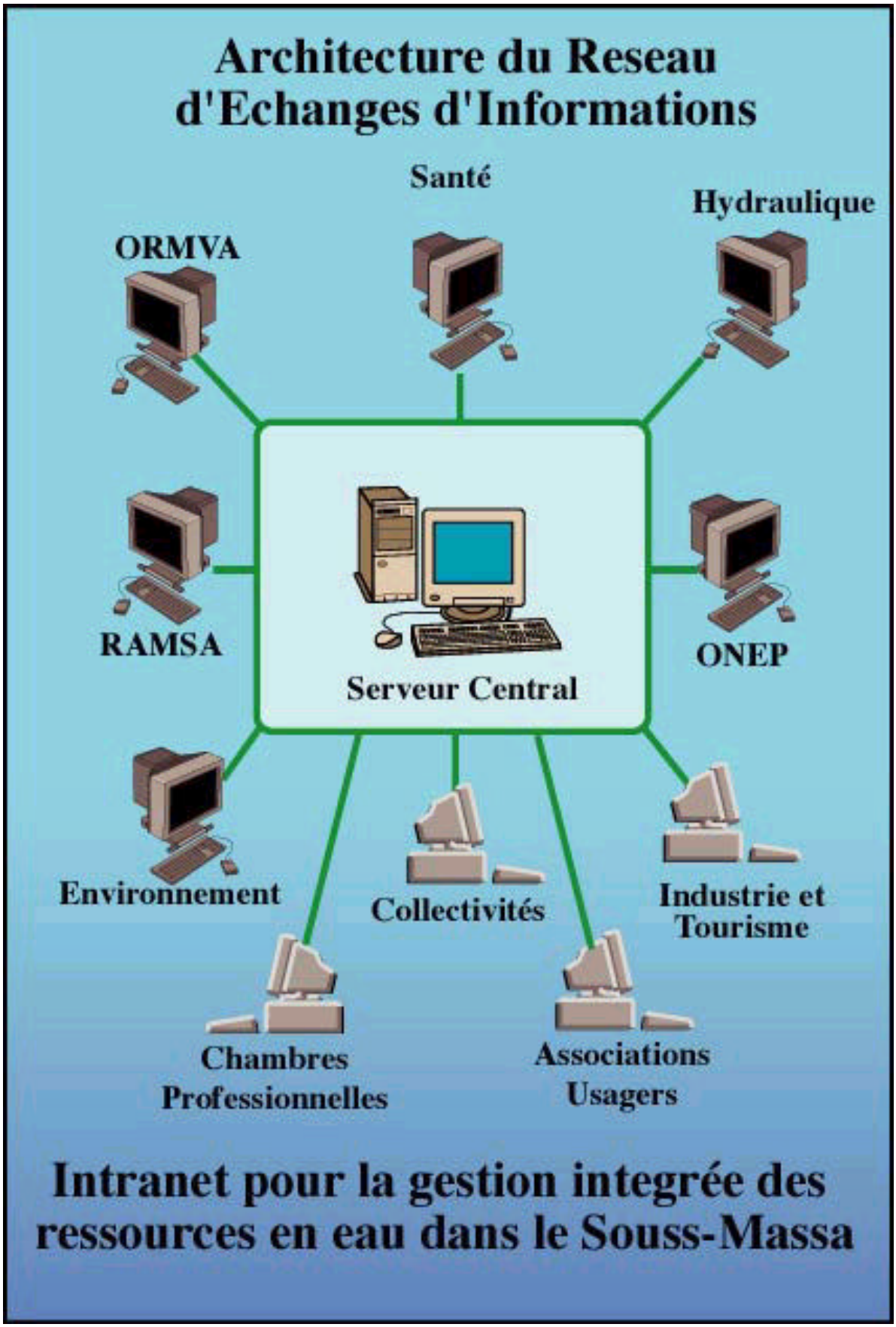
Design

New technologies that would facilitate the development of instruments capable of meeting the high level demand of the management of water resources and of the environment have appeared on the market. The choice of computer-based instruments has been limited in the past due to the extremely closed offer by manufacturers. Technology is currently evolving towards coupling information servers integrating spatial and non-spatial information in the same environment with highly diversified specialized customers of complex applications such as maps, object collection, model, Web clients, etc.

The realization of this project is based on two principles: creation of formalized permanent links among partners, and development of a participatory Web site as an exchange vehicle and platform.

Creation of links among partners: We recommend that state of the art Internet and Intranet links be set up among partners. The construction of these links would be carried out in close collaboration with partners. The global architecture is presented in Figure 5.3.

Figure 5.3 Souss Massa Information Exchange Network Design



Development of a Web site as a platform of exchange: A participatory Web site common to all partners should be set up. In fact, Web technologies put formalized possibilities of information exchange at the disposition of users. An Internet site constitutes one of the most modern tools for communication, publication, and data exchange. By creating a participatory Web site, we wish to support exchanges of information in real time and exploit synergies among partners. We chose this system because it provides other advantages sought by all. This exchange model allows:

- Formalization of information exchange
- Reinforcement of dialogue and data dissemination
- Exchange of data and of procedures among partners
- Development of means for intra-organization integration
- A tool for communication

Requirements of the Network

To make partners feel safe and to ensure a successful development for the Observatory, the following requirements must be met.

- For security and accessibility: Technology makes it possible to secure sensitive information through a system of codes. Access to information is limited to specialized organizations that have access codes. At the same time, technology makes it possible to provide information to a larger audience such as users, investors, and NGOs.

- Minimum cost, convivial environment, and speed of access: Technology is inexpensive, accessible in a user-friendly way, and does not require specialized know-how.

- Reactivity and accessibility: Information can be kept up to date and accessible in real time by organizations, users, and partners.

The process of building this platform of exchange is based on dialogue and participation.

Structure of the Site

The structure of the site is presented in Figure 5.4. The site will be built in a participatory manner and will comprise two distinct spaces:

- A platform reserved for partner organizations where every organization will have access to a platform specifically reserved for it. Each organization will feed information to its own platform.

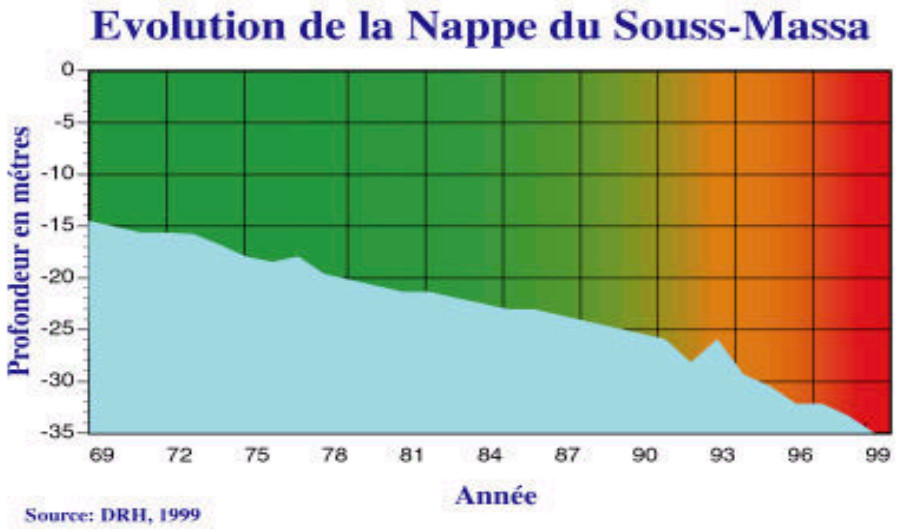
- An integrated common platform developed according to agreements between organizations. It will process themes of common concern: management of quality, quantity, payments, technologies, consulting with users....

Several degrees of sophistication can be provided to navigate textually, for those users who do not have sufficient processing capacities, or graphically, possibly under a map provider. The site to be developed will be accessible to all institutional partners,

users, and the public. For some databases, accessibility can be limited to certain organizations or user groups. Privilege and security systems will be provided for this.

Figure 5.4 Information Exchange Web Site Design

The Web Site includes 9 partners and deals with the following water management issues : Quality management, Quantity management, Regulation and authorizations, Technologies, Regional projects, Awareness, Advises to investors, Links.



Strengthening Human Resource Capacities

All the propositions must be supported by institutional measures to strengthen human resources in each agency. The following training needs have been identified:

- Automated data acquisition
- Database design, management, and maintenance
- GIS and graphic software
- Setting up information exchange networks
- Modeling and simulation (hydrology, agro-meteorology)

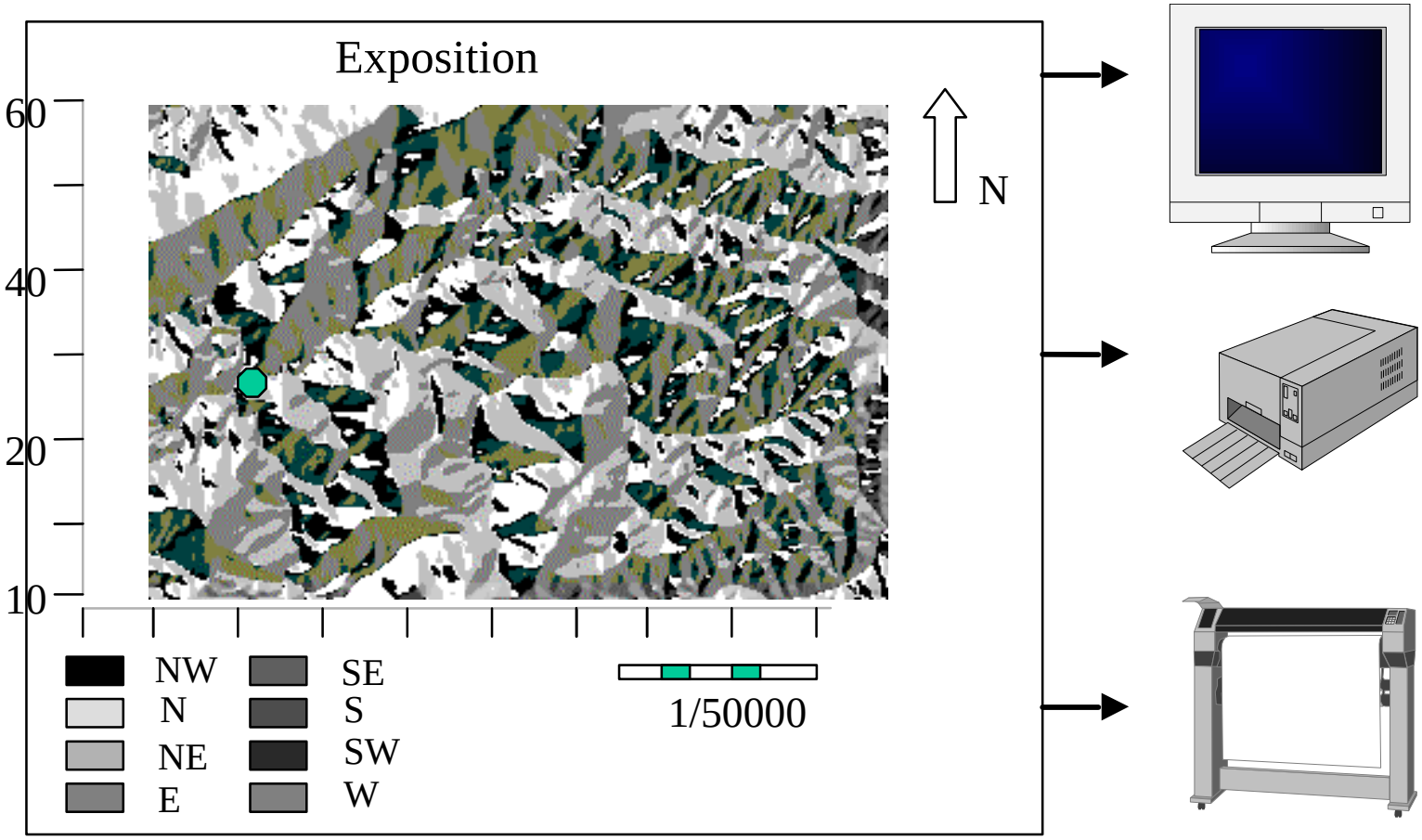
Building up the Hardware in Institutions

The propositions require acquisition of appropriate information technology equipment. The innovations to be introduced aim at improving the nature, structure, and power of the hardware through the introduction of provider/clients, the required connectibility, the appropriate backup systems (Zip, jazz, DAT), and the GIS platforms. For the latter, scanners, digitizers, and drawing tables will be required. The exact determination of needs will be done according to the recommendations accepted. See Figure 5.5.

Consolidating Participatory Mechanisms of Cooperation

This last recommendation will be discussed in Chapter 6.

Figure 5.5: Institutional capacity building (Hardware)



CHAPTER 6
REINFORCING COLLABORATION AMONG PARTNERS

The topic of the mission entrusted to FORWARD, database needs for integrated water resource management, is relevant for several reasons. On the technical level, reliable information is essential for the installation of a water resource management system and for decision-making in Souss-Massa. Coherent management integrated into each organization requires an effort of horizontal integration, reinforcing coordination among the agencies and organizations involved in the water sector.

This chapter focuses on the mechanisms that reinforce coordination and collaboration among the partners to ensure implementation of the recommendations suggested in this study. The suggested guidelines and collaborative procedures are based on field observations made during meetings with representatives of the water sector at the regional and national levels and on the results of the workshop (for the launching of SIWM) held in Agadir, April 26-27, 2000.

The chapter has two parts. In the first, we sum up the conclusions we came to during our diagnostic visits. In the second, we take up our recommendations in detail.

Results of the Diagnosis

During our visits, we had the opportunity to diagnose:

- The multitude of actors in the water sector. Although the duties of these actors concern a particular aspect of the sector, the duties become less apparent at the level of the interfaces.

- A kind of coordination among partners. For example, the Regional Management of Hydraulics held meetings to decide on water allowance. The Regional Office of Agricultural Development and the Regional Management of the National Office of Drinking Water, the two principal users of water, attended the DRH meetings. The Ministry for Equipment, which includes DRH, is a full member of the boards of directors of these two offices.

- Regional committees where the various partners are members. An example is the committee in charge of delivering permits for water withdrawals from the aquifer for agricultural purposes. This committee, coordinated by ORMVA, consists of DRH and the local authorities. Recently, a committee on the environment was set up in Agadir.

- Consensus over water law 10-95. All partners are convinced that its provisions are useful and hope that the implementation texts will reinforce this consensus.

- Coordination within each administration involved in the water sector. Almost all our meetings were held in the presence of the directors and their assistants (heads of divisions, heads of services, etc).

- Official procedures for information exchange. All those involved who have interface exchange information officially. (ONEP/DRH, ORMVA/DRH, ONEP/Public Health, and others).

- A major concern for the improvement of the databases. The participants in the Agadir workshop chose the theme of databases and information management in general as priority activities for SIWM.

- Political will for better water resource management. The Wali of Agadir confirmed this will in his opening speech to the workshop on integrated water resource management, April 26- 27, 2000.

We also noted the absence of:

- An institutional provision such as a committee entitled to make decisions on behalf of the partners. The presence of such a committee would have facilitated the introduction of a participatory approach to water management.

- A framework which would allow for data exchange and the removal of information monopoly.

- Coordination with regard to data collection. Some redundancy was observed in the collection of information.

- Professional occupations which reinforce communication. Divergences are often the result of lack of communication. The workshop, which was a good exercise, made it possible for all the partners to realize the importance of collaboration in water management in Souss-Massa.

- A strong collaboration among all the partners involved in the water sector.

Principal Actors

The principal actors at the regional level are DRH, ORMVA-SM, ONEP, RAMSA, and the Delegations of the Ministry for Public Health and the Ministry for Industry, Trade and Handicrafts. Major assets would lead these partners to favor convergence, instead of the observed divergence, owing to the fact that they are:

- Government departments which defend public interest
- Institutions which must fully respect the provisions stipulated by the law on water
- Actors conscious of the socio-economic stakes related to water scarcity

Implementation

Satisfaction in time and space of the demand for water by all the users is a requirement for the socio-economic development of the area. Taking up this challenge would require the implementation of rigorous policy-based reforms for water management. The FORWARD Project has contributed to improve, share, and make rational use of the regional databases.

To implement the suggested recommendations, FORWARD favors a methodology inspired by the SIWM project: the proposal of a committee made up of three governmental partners was the beginning of a profitable collaboration. Likewise, the organization of the workshop on integrated water resource management has been a positive experience and has helped to reinforce collaboration among partners.

It should be noted that the implementation of the recommendations put forth within this project does not require the promulgation of new legislative texts. However, there is a strong willingness among partners to take part and collaborate efficiently in the implementation process.

To ensure the best conditions for the implementation of the various recommendations, the following stages are necessary:

- Translation of each recommendation into a feasible project
- Appointment of a support committee made up of partners
- Implementation of the project in collaboration with the committee
- Evaluation of the project by the committee.

Throughout the implementation, it is of primary importance to use effective mechanisms to reinforce collaboration. Among these we favored participatory approaches, group-work, communication, availability of adequate means, and finally, professional facilitation of the meetings.

The Participatory Approach

The participatory approach in integrated water resource management is appropriate to use in Souss-Massa because of the variety of actors in the sector. By involving these actors in decision-making, the result will not only be ensured but also sustainable. With respect to information sharing, it is necessary to appoint a database committee to propose and decide on the nature of the data to be shared, the means of implementation, and the procedures for exchange. Involvement of all partners via this committee is the best guarantee of success for implementation of the recommendation. The committee will be present throughout the four stages to validate or make corrections if need be.

It should be noted that the participatory approach to water resource management, in particular, is rooted in the practices of the Souss-Massa local population. The approach was developed following the long and harsh drought cycles suffered in the last century. The area is thus ideal for the implementation of this approach at the institutional level since it is possible to build on what is already there. Moreover, the ingredients for a successful collaboration of the potential partners are already in place. They include the willingness of the local authorities and the technical skills in the field of water management, which will be reinforced if need be, and the technical assistance and training programs developed during the implementation of the SIWM Project.

Group Work

During our visits to the various administrations and offices, we observed that teamwork is the most dominant approach. Employees and civil servants are involved in various projects and are responsible for implementing the tasks related to them as

well as for the results. These people are involved in the meetings on the various aspects of their projects. It is thus clear that this approach is an aspect of the culture of these organizations. In subsequent stages, this approach should be strengthened in such a way as to allow inter-organization teams to be set up. During the April seminar, the teams trained to work on the essential themes of the workshop included members from the various organizations. Such working groups should be set up more frequently.

Communication

The April workshop was a rare opportunity to inform the participants about USAID projects in Souss-Massa. It was also an opportunity for the partners to get information about each other's activities. The picture of the water situation in Souss-Massa drawn by DGH left no one indifferent. The flow of accurate information through reliable channels would promote trust among partners. The rapporteur of the Technical Committee, SIWM Project, clearly explained that the new organization to be set up at the level of the river basin of Souss-Massa will become a forum for communication, continuous exchange of information, and consensus among partners in the decision-making process.

To eliminate any risks related to communication, specialists in organizational development can be called upon. They can set up a whole communication program in collaboration with partners. It would be advisable to call upon these experts during the creation process of the Souss-Massa river agency.

Adequate Resources

Any effort designed to strengthen collaboration among partners is bound to fail if it is under-resourced. Resources vary from know-how to logistics. In the case of the FORWARD Project, all the partners have agreed that sharing information can be a good starting point for a strong and sustainable collaboration. The implementation of this project will undoubtedly require expertise in databases and acquisition of data processing equipment. Shortage of these resources will inevitably result in the failure of the whole project. Follow-up committees commissioned for a given aspect need to make an inventory of the available resources and to match them with expectations. Any imbalance will require an adjustment in programming the objectives.

Professional Facilitation

To capitalize on the contribution of the April 2000 workshop related to communication and participatory approach, the next meetings, which will be held in Agadir, must be efficiently run. Three aspects must be taken into account: facilitation of the meetings, definition of the basic work rules, and drafting of reports on the various meetings. These three aspects are taken up in more detail below:

Facilitation of the meetings: It is recognized that a working group is only efficient if its meetings are well facilitated. Basically, a facilitator is someone who meets the needs of a group by helping them concentrate on the topics of the agenda while monitoring the time and maximizing the participation of all the participants. A good facilitator must be knowledgeable about the themes discussed. This enables him to help the group to find a ground of agreement on a set of objective bases. Within this framework, the concept of "neutrality" is significant. A neutral expert is not necessarily

an outsider. The three criteria for selecting facilitators are that they are competent enough to conduct a meeting professionally; that they can gain the confidence of the group; and that they avoid expressing their own opinions so as not to influence the decisions of the group.

Basic work rules: The first task of the facilitator consists of defining the bases to be used as a frame of reference during the work of the group. Experience has shown that these rules are effective when they are implemented right at the outset of the meeting. They must pertain to:

- Definition of the objectives of the meetings;
- Identification of the members of the working group;
- Definition of the results to reach in the allocated time;
- Responsibilities of the facilitator, who is sometimes a member of the group;
- Identification of a network to ensure the flow of information;
- Definition of the manner in which the notes on the points discussed will be taken;
- Definition of the people who will have the access to the reports;
- Definition of the roles of the members of the committee; and
- Decision concerning the manner with which the public will be dealt with.

Summaries of the meetings: Summaries of the meetings are important tools for ensuring working group productivity. They serve as a reference for all the meetings and specify the responsibilities of individual members of the group. The minutes of meetings differ in terms of the details selected. We recommend that the working groups set up in the framework of the SIWM Project use the "bullet summary" approach which consists in reporting succinctly the essential points discussed. These notes, easy to understand, must contain two types of information: actions to be implemented and decisions taken. The notes make it possible for the group to recall in a precise manner the decisions taken and the tasks to be carried out by each member of the group.

Training

For each recommendation put forward within the framework of the FORWARD project, training was recommended as a major action.

Conclusion

To implement the recommendations presented in Chapter 4 we recommend adopting an approach which would promote the profitable collaboration discussed in this chapter. It is obvious that a regional committee and working groups to implement the recommendations should be made up so as to ensure good coordination of the various activities in Souss-Massa. The working groups should be staffed with personnel operating both in Souss-Massa and at the central level. Choices will be made according to the required skills and decision-making capacity. The SWIM National Committee should organize a workshop within the six months following the launch of the project to communicate its evolution and obtain the observations and suggestions of the participants concerning subsequent stages of the project. These aim to develop the existing databases and maximize data sharing and usefulness. For this, an audience similar to the participants in the April workshop should be convened. Immediately after the workshop, the National and Regional SIWM Committees should meet to define priorities and set up an action plan for the next six

months basing their decisions on the results and the feedback received in the previous period.

CHAPTER 7
ACTION PLAN FOR IMPLEMENTATION

Integrated water management is characterized by a participatory approach which not only aims to define a balance between the various functions of the environment and the uses of water, but also seeks to reach and preserve this balance by implementing actions. These actions can be legal (regulatory measurements), technical (structural measurements), or institutional (organizations). In Souss-Massa, the regulatory aspects of water management are defined by the provisions stipulated in the various laws such as the law on water and its current and future decrees for application.

As for the technical and institutional aspects, several actions need to be carried out in order to achieve an improvement of the technical management of water resources. Being aware of the importance of information in the decision-making process, this study has shown the need for setting up integrated information systems.

Presentation of the Action Plan

The action plan we present in this report is structured around seven projects. The elements of each project are described below.

Project 1: Harmonization of the Databases (White Guide). The project consists of standardizing the collection, processing, management, and transfer of information methods in all partner organizations of the area. Implementation of the six actions constituting the framework of this project will be spread out over 18 months. The details of this project are given in Table 7.1.

Project 2: Automation of Data Collection for Information Systems. The project objective is to introduce telemetering systems in Souss-Massa for the collection of quantitative and qualitative information in various fields. Structured around five actions, this operation aims to improve the quality of collected measurements, reduce the collection/utilization time of the data, and reduce collection costs. Implementation time is estimated at 24 months. Information concerning this project is given in Table 7.2.

Project 3: Updating Groundwater Databases. Understanding the situation of the water table is essential for a good water management in Souss-Massa. In fact, reliable information empowers those in charge of water management to take measures to stop the increasingly worsening overexploitation of the water table. Structured around four actions, this project aims to supplementing the groundwater databases, quantify water withdrawal in time and space, propose a basic model of data with an integrated architecture, and develop a procedure for updating the values of the database according to a set schedule. The importance of this project necessitates its implementation within 15 months. The details of each action are given in Table 7.3.

Project 4: Transfer of Databases to the Region. This project concerns the transfer of the BADRE21 database from DGH to Agadir DRH and the ORMVA-SM to the entities of the office located in the perimeter. This operation makes it possible to

capitalize on the existing database management systems. Based on five actions, it will be spread out over 12 months. The details of this project are reported in Table 7.4.

Project 5: Introducing GIS into the Databases. This project consists of equipping the databases with GIS systems to improve their capacity for illustration, exploitation and interpretation. The project is designed with four actions over 12 months. Other information concerning this project is reported in Table 7.5.

Project 6: Creating a Web Site for Information Exchange. This is the ultimate stage of the collaboration process. This operation, which consists in setting up a Web site on water resources in Souss-Massa, is made up of five actions. The maximum duration for carrying out the project is estimated at 15 months. The details concerning the the project are reported in Table 7.6.

Project 7: Developing a General Management System. This project involves developing a management and information system to satisfy the future needs of the partners of the project and those of the projected basin agency. In addition to the quantitative aspects related to water resources, this management system must ensure the interfaces among the partners and the customers of the agency (financial and accounting aspects). We propose that the study and the implementation of this project be the objects of another USAID mission.

Timing of the Action Plan

It is of primary importance to launch the implementation of the projects suggested in this report to allow the SIWM Project to benefit from the dynamics created in the region, namely the FORWARD mission and the April workshop on water resource management in Souss-Massa. We consider that two years is largely sufficient for carrying out the action plan. The implementation schedule proposed is presented in Tables 7.7, 7.8, and 7.9.

Table 7.1
Execution Plan for Project 1: Harmonization of Databases (White Guide)
All Regional Organizations

Actions	Action objectives	How to conduct the plan	Who is in charge of the action	Deadline Zero time: June 2000
1. Create a committee on databases.	Coordinate all actions	Organize a workshop on databases	FORWARD	Within 3 months
2. Harmonize data collection, presentation, and exchange	Necessary stage for fruitful collaboration	Participatory approach with agreement among partners	Committee supported by technical assistance (FORWARD)	6 to 9 months
3. Harmonize techniques for analysis and operative modes	Facilitate interpretation of information and establish a environment of trust	Participatory approach with agreement among partners	Committee supported by technical assistance (FORWARD)	6 to 9 months
4. Share collected information among organizations by action zone	Economy of means	Participatory approach with agreement among partners	Committee supported by technical assistance (FORWARD)	Within 12 months
5. Identify channels of information exchange	Common among the committee members	Participatory approach with agreement among partners	Committee supported by technical assistance (FORWARD)	Within 15 months
6. Develop a white guide	Implementation	Participatory approach	Technical assistance (FORWARD)	Within 18 months

Table 7.2
Execution Plan for Project 2: Automation of Data Collection Systems
DRH, ORMVA, and ONEP

Actions	Action objectives	How to conduct the action	Who is in charge of action	Deadline Zero time: June 2000
1. Identify fields of action and needs in telemetry	Assess the importance of the action and the necessary means for implementation	Study: Compile documents and field work	Technical assistance USAID (FORWARD) and interested agencies	Within 6 months
2. Present options for telemetry systems in terms of types of measurement	Make a good choice given the price/quality	Study	Technical assistance USAID	Within 9 months
3. Install a pilot site for each area of intervention	Validate the choice, and use the sites for training	Install systems	Equipment suppliers Technical assistance	Within 18 months
4. Test and start-up of pilot sites	Make sure of the progress	Start-up and tuning	Suppliers, organizations, and technical assistance	Within 18 months
5. Follow-up and evaluation	Evaluation	Visits and monitoring	Organizations and technical assistance	Within 24 months

Table 7.3
Execution Plan for Project 3: Updating Groundwater Databases
DRH, ORMVA-SM, ONEP

Actions	Action objectives	How to conduct the action	Who is in charge of action	Deadline Zero time: June 2000
1. Inventory available information on the water table	Gain familiarity with the current situation	Compile the available documents	Interested organizations and technical assistance	Within 3 months
2. Collect information on all samplings	Have sufficient understanding about water table draw down and water quality	General surveys and information processing	Organizations supported by technical assistance	Within 12 months
3. Develop a regional database on the water table	Make information available	Study: Design and installation	Interested organizations and technical assistance	Within 15 months
4. Develop instruments for updating the database	Update information	Procedure and planning to update values	Interested organizations and technical assistance	Within 15 months

Table 7.4
Execution Plan for Project 4: Transferring Databases to the Region
DRH, ORMVA, and ONEP

Actions	Action objectives	How to conduct the action	Who is in charge of the action	Deadline Zero time: June 2000
1. Identify and improve the databases to be transferred and identify transfer targets	Assess the importance of the action and the necessary means for implementation	Study: Compile documents and fieldwork.	Technical assistance USAID (FORWARD) and interested agencies	DRH is already on target for BADRE21 Within 3 months for ORMVA and ONEP
2. Evaluate needs in equipment, network cables, and choice of options	Evaluate the necessary means for implementation Make the best choice given price/quality	Study	Technical assistance USAID	Within 6 months
3. Acquisition and installation of various equipment and network cables	Implement the activity	Install equipment	Suppliers, organizations and technical assistance	Within 9 months
4. Test and start-up	Ensure adequate operation	Start-up	Suppliers, organizations and technical assistance	Within 9 months
5. Follow-up and evaluation	Evaluation	Monitoring	Organizations and technical assistance	Within 12 months

Table 7.5
Execution Plan for Project 5: Introducing GIS into Databases
All Regional Organizations

Actions	Action objectives	How to conduct the action	Who is in charge of action	Deadline Zero time: June 2000
1. Establish a training program for DBMS and GIS	Extension of DBMS and GIS	Seminars and case studies for representatives of each organization	Technical assistance USAID	Within 3 months
2. Identify which organization will host the pilot experiment	Necessary stage in the process of the activity	Make the selection by the end of the training program	Technical assistance and database committee	Within 3 months
3. Develop a pilot operation	Implement a demonstration Introduce GIS gradually	Workshop Organize a participatory DBMS linked up with GIS	Technical assistance	Within 6 months
3. Generalize with a participatory design of a general GIS and implementation	Generalize the use of the tool	Generalize the pilot action	Technical assistance	Within 9 months
4. Establish training programs in DBMS and GIS for the users within each organization	Ensure adequate use of the tool	On-site seminars	Persons involved in previous activities supported by technical assistance	Within 12 months

Table 7.6
Execution Plan for Project 6: Creating an Information Exchange Web Site
All Regional Organizations

Actions	Action objectives	How to conduct the action	Who is in charge of the action	Deadline Zero time: June 2K
1. Define common platform	Define information to be disseminated, access, and exchange protocols.	Meetings	Committee on databases and technical assistance	Within 3 months
2. Design the site	Global view of potential content	Technical discussions	Committee on databases and technical assistance	Within 9 months
3. Meet equipment needs	Select appropriate hardware, connectors, and software	Technical discussions	Committee on databases and technical assistance	Within 9 months
4. Implement and test	Design, install, and test the site	Choose a demonstration agent	Committee on databases and technical assistance	Within 12 months
5. Install provider(s)	Install hardware and software, construct an http address	Choose a host/venue for the provider	Committee on databases and technical assistance	Within 15 months

Table 7.7
Action Plan Schedule for Projects 1 and 2

Project	Execution deadline	Actions	Months							
			3	6	9	12	15	18	21	24
Project 1: Harmonization of the Databases (White Guide)	18 months	1. Setting up a committee on databases.	→							
		2. Harmonizing data collection, presentation, and exchange	→	→	→					
		3. Harmonizing techniques for analysis and modes of operation		→	→					
		4. Sharing the collected information among organizations by action zone			→	→				
		5. Identifying channels of information exchange				→	→			
		6. Drafting a white guide					→	→		
Project 2: Automation of the Data Collection Systems	24 months	1. Identifying the fields of actions and the needs in telemetry	→	→						
		2. Presenting options for telemetry systems in terms of measurement		→	→					
		3. Installing a pilot site in terms of fields of actions			→	→	→	→		
		4. Testing and start-up of pilot sites							→	
		5. Follow-up and evaluation							→	→

Table 7.8
Action Plan Schedule for Projects 3 and 4

Project	Execution schedule	Actions	Months							
			3	6	9	12	15	18	21	24
Project 3: Updating Groundwater Databases	15 months	1. Surveying the available information about the water table	→							
		2. Collecting information about the samples	→	→	→	→				
		3. Developing a regional water table database		→	→	→	→			
		4. Developing instruments for updating the database				→	→			
Project 4: Transferring Databases to the Region	12 months	1. Identifying and improving databases to be transferred; identifying transfer targets	→							
		2. Assessing needs in equipment and network cables and choosing options	→	→						
		3. Acquiring and installing a variety of equipment and network cables.		→	→					
		4. Testing and start-up			→					
		5. Follow-up and evaluation			→	→				

Table 7.9
Action Plan Schedule for Projects 5 and 6

Project	Execution deadline	Actions	Months							
			3	6	9	12	15	18	21	24
Project 5: Introducing GIS into the Databases	12 months	1. Establishing a training program for DBMS and GIS techniques	→							
		2. Identifying the organization to host the pilot experiment	→							
		3. Developing the pilot operation	→	→						
		4.Generalizing: participatory design of a general GIS and its implementation		→	→					
		5. Training in DBMS and GIS techniques for users within each organization			→	→				
Project 6: Creating an Information Exchange Web site	15 months	1. Defining a common platform	→							
		2. Designing a site		→	→					
		3. Determining equipment needs		→	→					
		4. Implementing and testing			→	→				
		5. Installing provider(s)				→	→			

ANNEX
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